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ABSTRACT

Though previous research has attempted to correlate television viewing with educational outcomes, little research has been done to establish the links between modes of presentation, individual styles of learning, and achievement. Eye movements, for instance, are markedly responsive to differences in presentation, especially to such factors as the placement on the screen and the amount of animation used. The effectiveness of production variables depends on visual processing, and the processing style is, in turn, both the modifier of and modified by cognitive structure. Research using the children's program "The Electric Company" has shown that certain cueing techniques are powerful determinants of "looking" behavior. Future research will probably focus on the production techniques which most effectively modify the viewer's attention. (EMH)

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CUES AND ATTENTION TO THE VISUAL DISPLAY IN CHILDREN'S TELEVISION

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The rapid, nearly incredible growth, of instructional television in the last decade is such that it has far out-stripped attempts to formulate theories of learning or instruction related to its particular qualities. In general, the meagre research that has been conducted has tended to ignore the special properties of the medium and to treat it as an undynamic mode of instruction. Emphasis has been placed upon cumulative performance in the subjects' attainment of the educational goals of the given program but much less investigation has been directed at how these gains have been achieved or why they have not been realized. Furthermore, television has not been thoroughly researched for its intrinsic power to teach. That it does teach is quite well documented [Ball and Bogatz (1973), Fowles (1973), Briggs (1973), Rovet (1974)] but how it teaches, the extent of its instructional limitations, the degree to which it is unexploited and (perhaps the key question for in-the-home programs) the relationship between entertainment and instruction has had but light interest from capable researchers.

Nevertheless, television has become increasingly important as a medium through which material of a wide range of richness and complexity is transmitted to very large numbers of people. Much of this transmission occurs in the commercially-oriented, real world of network-broadcasting, and is aimed at the adult viewer in a frankly

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competitive, essentially leisure-oriented form. There is also a growing and increasingly sophisticated proportion of broadcasting that has been directed at the preschool and school-aged child. Part of this transmission occurs as commercial programming which combines product-selling with educational orientation, and part as non-profit, direct attempts at instructional television aimed at home viewing and at classroom use.

In its more direct attempts at instructional forms, television offers the viewer a vast range of visual and auditory options, far in excess of those available from any other source. It has many special effects for leaping physical, spatial and temporal boundaries in the service of concept formation and in bringing together the critical set of exemplars in the contiguous presentation that is most efficient for learning. Furthermore, it can be especially effective in imparting those abstract concepts which are increasingly coming to be viewed as critical in order for the child to gain most benefits from reading instruction [Downing (1971), Gleitman & Rozin (1973)] .

As Fowles has pointed out (1973), television can bring auditory (voice) symbolic (print) and representation (object or event) modes together to reinforce one another. As one example, the simultaneity of the written and spoken representations, together with a dynamic cue to their correspondence may serve to concretize and crystalize the abstract notion that print tracks speech much more effectively than could any verbal explanation of the process. It has also the capacity to present these integrations in a range from fantasy to reality and can, under favorable conditions, induce active participation and involvement on the part of the viewer. Yet, with a few

notable exceptions, the theoretical researcher and his applied counterpart have had little to say either in the development of programs or in the assessment of their effects upon different classes of viewers.

As a result, production has depended very often on artistic, intuitive approaches, while summative research on outcomes has been largely aimed at main effects only. The opportunity provided by television for close study in a non-coercive manner of human perceptual and cognitive processing, of information and skill acquisition, and of affective variables has been relatively ignored.

In those studies in which television as an instructional medium has been a primary concern it is interesting to note that much of the data reported is of the "after-the-fact" type. That is to say, segments or full programs are shown, and only after their conclusion is the subject tested. Methods have included verbal reports (Fowles 1973), observational analyses [Ahlwat (1971), Liebert (1973)] developmental analyses (Rovet 1974), and multi-variable recall studies (Salomon 1972). While this work is of value in assessing the overall outcome of programs it is possible that it does not fully incorporate or exploit the dynamic quality of television - perhaps its essential characteristic. Studies which have attempted to assess viewer reactions during the course of the segment or program [De Vries (1971), Liebert (1973)] are few and have relied for the most part on observer checklists. Rarely indeed [Wolf (1972), O'Bryan & Silverman (1972, 1973), Briggs (1973), Mock (1974)] has any part of the interaction of the subject with the program been directly observed in a real time sense. In each of these studies, the viewing patterns of the subject were investigated by monitoring his eye movements - a procedure which

enables direct investigation of the point of regard on the continuing program.

Television by its nature has a particularly flexible and variegated potential for presenting reading instruction programs to all classes of viewers from preschoolers to adult illiterates. Were the materials to be delivered simply as an electronic book, following basically the techniques of the page-bound publisher and holding print static on the screen, it would be unlikely that special eye movement research on television programs would be useful. In other words, the generalization of eye movement findings [Yarbus (1966), Zaporozhets and Zinchenko (1965)] from text and pictorial materials in static displays could be made to television programs with a relatively low degree of risk. But when it is considered that television can match the action to the word, and can create an almost endless variety of animated, electronic, humanized or fantasized presentations of print and pictorial stimuli, the special role of eye movement research in the medium may be seen.

While not in any way restricted to instructional television and applicable to all forms of point-of-regard studies in television viewing, this technique proved to be especially valuable in the specific case of instructional reading programs, primarily in the Children's Television Workshop's "The Electric Company".

Studies by O'Bryan and Silverman (1972), Briggs (1973), O'Bryan (1975), O'Bryan and Hodapp (1975), and Hodapp (1975) indicated that eye movement patterns are markedly responsive to differences in presentation of program segments in television reading programs and can be expected to vary substantially according to the

subject's level of skill in reading. These studies, which were originally largely formative in nature, have generated program adaptations that have produced predicted changes in viewing patterns among poor readers and illiterates. Furthermore, there is some evidence (O'Bryan 1974) that these modified viewing patterns reflect a better attack by the learner on the presented stimuli and that this, in turn, leads to more effective learning of the instructional segment.

Several specific findings related to instructional reading programs emerged from the research. When considering the question of position of print on screen (for example), it was noted that the best location, in terms of number, duration and pattern of eye movements, appeared to be central, preferably between eyes or at eye level. It was found also that balloons drew more attention than other forms of presentation, while bordering variation seemed to have little marked effect on looking behaviour. Nevertheless, zoom boxes were very effective and when placed at the eye level of the actors tended to generate more looking activity. In terms of type of print the findings suggested that static print proved least effective, while flashing but stationary print drew substantial looking behaviour. Better scan patterns were generated by animated print but there was clear evidence that computer produced print was most effective of all, especially when not presented in competition with live actors.

Animated and graphic presentations produced the highest level of looking behaviour and reflected the closest approximation of normal reading eye-movements and scan patterns in almost all studied groups. Cartoon sequences tended to produce more fixations on the stimulus among poor readers than did live action, possibly because of

reduced distraction material, and as a result of clearer lines, specific pointing, etc. Subsequently it was found (O'Bryan 1975) that the incorporation of these principles of position, zoom, animation and minimal "business" increased eye movement ratios on the primary message.

Most recent results (Hodapp 1976) have shown a significant negative correlation between the amount of action and eye movement attention to the educational message. Live actors were most compelling stimuli to the subjects in these studies and children in all groups attended much more to the actor than to stimulus words whenever the two appeared simultaneously. When action occurred first, followed by the message, reading type EMPs improved in the slow readers and most of these children attended directly to the stimulus, often displaying EMPs common to good readers. A similar phenomenon was observed when the message was greater in magnitude, dominant in intensity or preeminent in position.

Some particularly fine research was conducted by Mock (1975) in the use of eye movements to examine relationships between audio and visual stimuli. She found that the higher the reading level of the subject, the faster was the visual orientation to print on the screen, and the greater the percentage of fixation time on print. These subjects also displayed less random and off-screen fixations. Most interestingly, she discovered that children's

> "viewing strategies can be altered by the utilization of various audio-visual factors. In general, attention to print was increased when there was a delay or absence of voice over, when there was little or no competing video component, when the print itself moved, or with the use of cues, instructions, or repetition of format. Exact repetition and very long duration of exposure tended to decrease attention to print."

Mock argued that reading ability interacted with attention to animated pictures, with variations in the sound track, and with the duration of exposure of the stimulus.

These findings and those reported earlier in the paper imply that the actual performance of a skill, and the continued learning of it are closely related to production variables in the program itself. In other words, the creator of the particular television presentation is in a position to directly and quite precisely modify the looking behaviour of the viewer by variously adapting specific elements and techniques of production. Furthermore, the correlates of these adaptations appear to be related to cognitive, learning and attentional characteristics within the viewer.

Many researchers have argued that visual processing is directly related to existing cognitive structure and is, in an interactive sense, both the modifier of and modified by this structure, but few have closely investigated the potential of television (and film) for controlling such processes or for providing dynamic and readily modifiable stimuli for their examination.

It might be asked why production techniques have developed as they have. Is this simply a result of increasingly available advanced technology (split screens, zoom lenses, superior editing devices, instant playback, computer animation, etc.) which begs for a use and therefore creates a technique? Or has there been a gradual approximation to the visual processes themselves so that (for illustration) split screens represent divided visual attention in which monitoring occurs while primary attention is directed to the current salient section. Do zoom shots represent tunnelling to specific

areas of high content in the visual field? Superior editing techniques may themselves be similar to executive functions (c.f. Pascual Leone, 1968) and relate to selective attention. Instant playback may be analogous to memory and represent electronically short term recall variables, computer animation may relate to the investment of reality with fantasy and reorganization, etc.

If, as it has been suggested by our previous research data, some relationship exists between the mode of production of a television sequence and the viewer's attention to, internalization or processing of the information or concepts contained in the sequence, it is possible that a match could be effected between the production and the process provided that the viewer can be effectively cued according to the producer's design. In other words, it may be that the producer will be able to model, in a locked-time sense, the critical images that the viewer needs to extract from the stimuli in such a completely effective way that he or she will process the information and establish the concept almost isomorphically with the producer's intention. This, of course, is a clear case of "Good and Bad News," both of which probably need no explanation.

Some of our most recent work at O.I.S.E. points, however, to the continuing development of the Good News side of the coin. This research has been conducted by Hodapp and O'Bryan on "cueing." Again, "The Electric Company" provided much of the stimuli, and again groups of children with differing reading skills were used as subjects. In addition, however, data were obtained from adolescent (14-17 years) deaf children viewing a specially captioned and "signed" news and current affairs program and from 4-to-5 year

old children who viewed locally made problem solving segments.

In certain respects remarkably similar eye movement patterns occurred. Specifically, these had to do with the effectiveness of the cueing of the subject to the salient, or predetermined area of prime interest.

While many types of cue are available to the producer, there seemed to be generally heavy emphasis upon three main types which were classified as mechanical, human, and animated/electronic. In each of these,there were direct and indirect cueing.

Under the mechanical cue type were included zooms, flickering displays, pointers etc. which had no live actor involved. Human cueing included all activities of live actors or human type puppets when attempts were made by them to direct the attention of the viewer to the salient point. Animated/electronic cueing included similar attempts by animated or electronic characters. Direct cueing referred to a specified command by the cueing agent to attend to a part or all of the stimulus. Indirect cueing did not so specify and allowed the viewer a choice of attention centering.

There was evidence in the results from all groups that cueing is a most powerful determinant of looking behaviour, and that a generally consistent attentional pattern results according to the nature of the cue and the strength of its delivery. There is a very strong effect apparent whenever an actor's eye cues are given. Almost all subjects will follow the presumed path to the target, provided the actor, on giving the cue, does not continue with additional activity. Star and think balloons in animated segments of "The Electric Company" had substantial cueing force. Some quite remarkable

anticipatory eye movement patterns occur when cues are well established and are not interrupted by extraneous action. Furthermore, a significant number of subjects leave the critical point of the display when cues are inadequate or do not lead to expected targets.

The research seems to indicate that direction of attention to the specific element desired can be obtained largely through clean and accurate cueing. When competing or inadequate cues are given, loss of specificity occurs and this appears to result in a reduction of attention on the part of the viewer. What is perhaps most interesting is that there are emerging consistent patterns which define the adequacy of cues and provide an indication of the best methods of directing children's attention most effectively towards the instructional message.

Should these data continue to replicate and as they become more elaborated they may well provide a close representation of a most parsimonious method of presenting the visual stimulus.

In the broader sense of general visual processing, some additional interesting data have emerged from the current studies. We have noted, for example, that many subjects appear to require rest breaks followed by periods of high arousal, somewhat similar to Berlyne's notion of arousal differentiation implying need for movement to and from an optimal level. When programs have this "pacing" which experience and intuition have always indicated as important, there are substantially fewer off-target fixations recorded.

Another area of interest concerns the tendency of many subjects to display eye movement rates that appear to be related to the affective content of the segment. While this area is still largely unexplored, we have noted much more activity in segments

in which dramatic tension is high than is the case otherwise.

While the research summarized above does not approach the testing of models of visual and cognitive processing in television programming, there appears to be within it some evidence that viewing patterns of individuals can be modified and, to a quite substantial degree, directed by attention to derived principles. As such it presents a promise, a problem, and a responsibility to the researcher, the educator and the producer. The promise is fairly obvious in that it will enable us to better present material that we design for whatever purpose we have in mind. The problem is also not too hard to see - the procedures have the very real manipulative potential that occurs when a technology becomes available and is usable by a few for presentation of a product to many. The responsibility is most difficult to assign.